

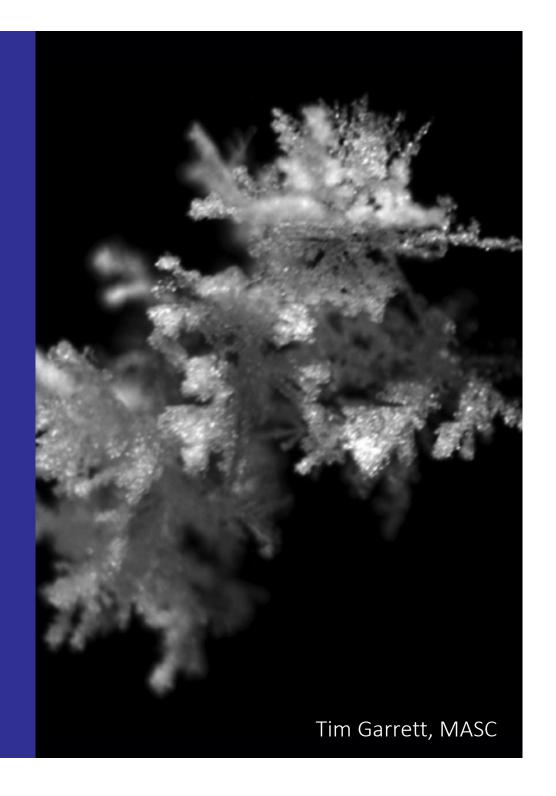






Density of snowflakes based on surface observations:

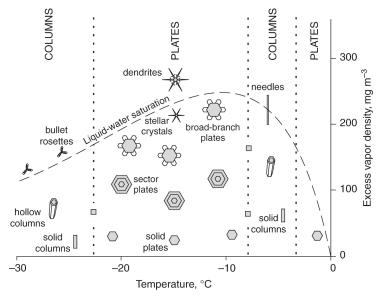
Comparison between snow particles at CARE (Canada) and Hyytiälä (Finland)



A. von Lerber, D. Moisseev, W. Petersen, P. Rodriquez and D. Hudak

How different is snowfall worldwide?

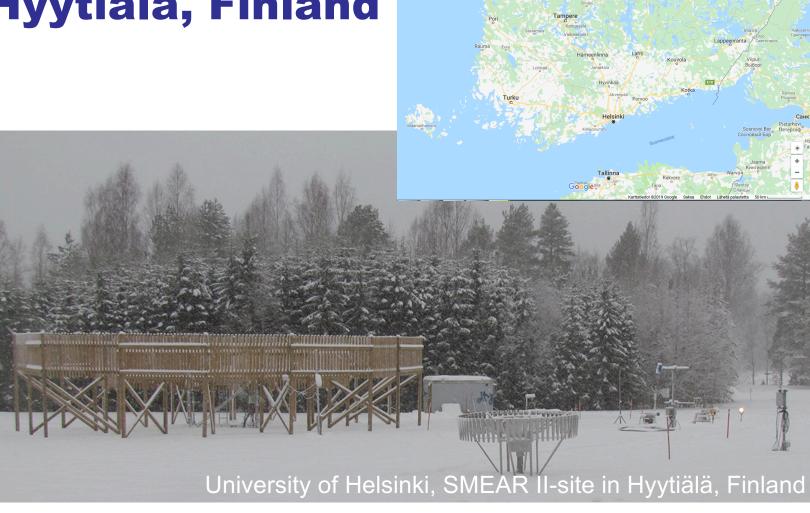
- In-situ observations
 - validate the remote sensing observations
 - help to establish the link between physical properties of snow particles and remote sensing observations
- Irregular structure of snow particles and continuous changes due to microphysical processes
- Long term in situ datasets since 2014



Lamb and Verlinde, 2011



Hyytiälä, Finland



Suomi



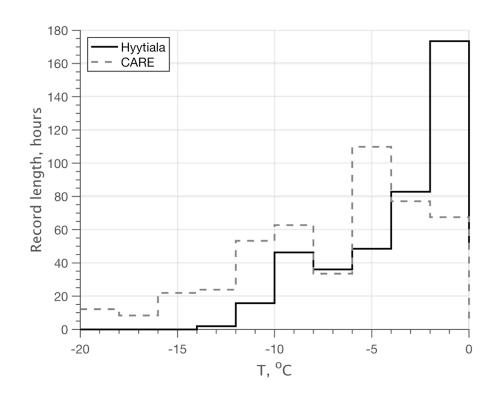
CARE, Canada





Temperature regimes

 Snowfall events at CARE site are more colder, whereas at Hyytiälä the events are mostly occurring closer to temperature of 0°C.





Mass retrieval

- Hydrodynamic theory + scaling factor from gauge
 - Böhm 1989
 - Mitchell and Heymsfield, 2005
 - Khvorostyanov and Curry, 2005
 - Heymsfield and Westbrook, 2010







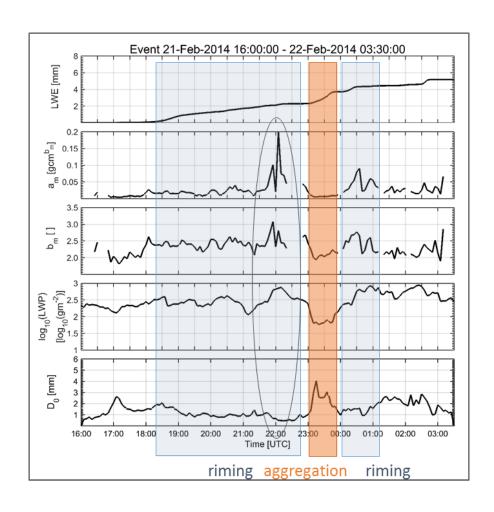
Size, estimate of shape and fall velocity

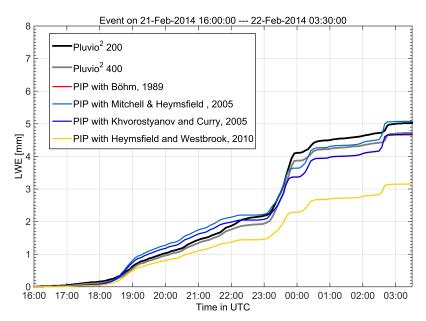


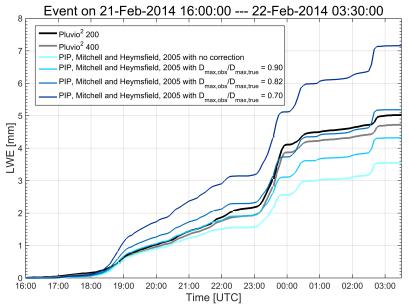
Ensemble mass



Uncertainties in mass retrieval

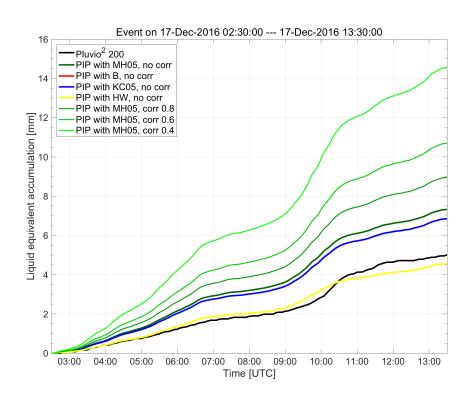


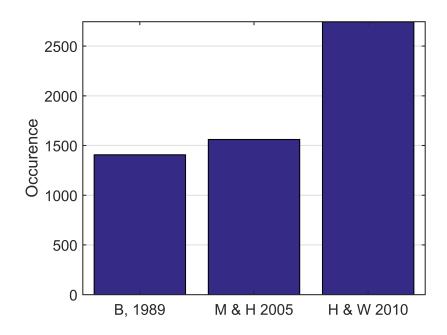




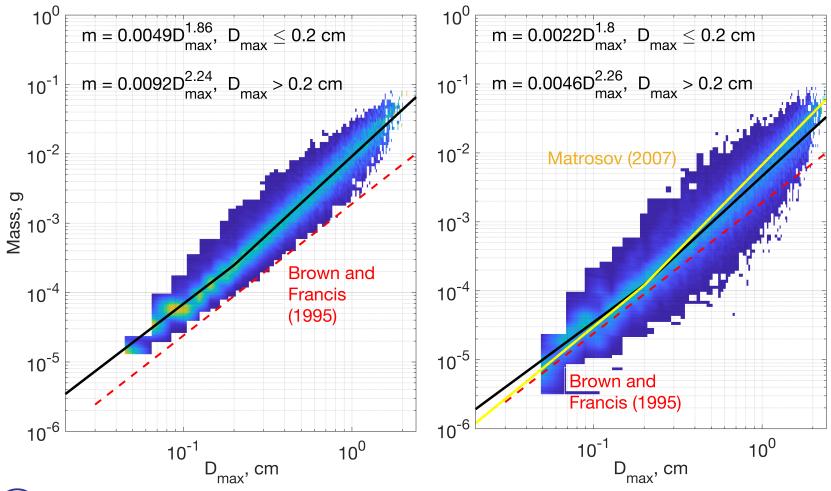


Uncertainties in mass retrieval





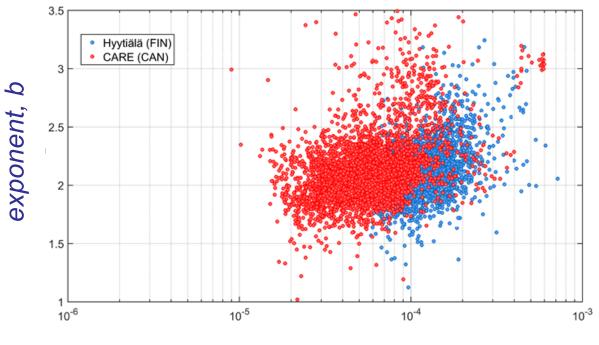
Mass retrievals at Hyytiälä and CARE





Mass retrievals at Hyytiälä and CARE

$$m = aD^b$$

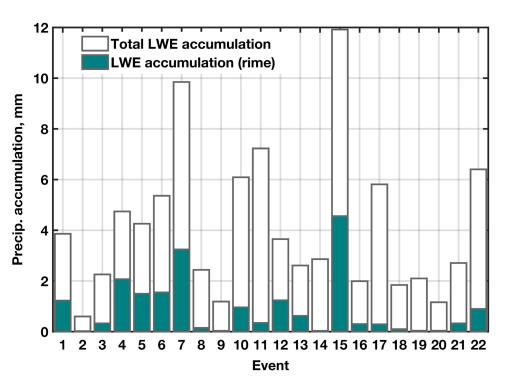


prefactor, a



Riming

 5-40% of the precipitation accumulation is resulting from riming in Hyytiälä



Moisseev et al. 2017

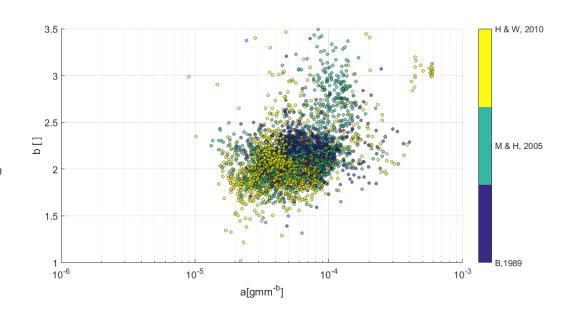


Mass retrieval dependence on parametrization

Heymsfield and Westbrook, 2010

- low-density particles
- Mitchell and Heymsfield, 2005
 - denser particles

CARE

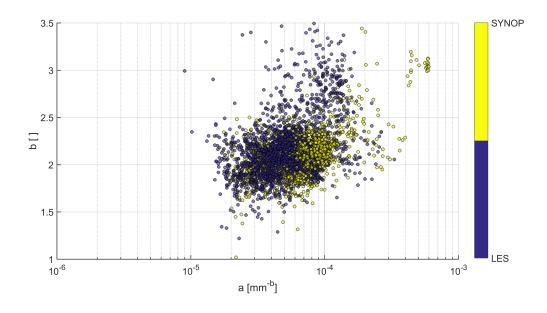




Mass retrieval dependence on snowfall classification

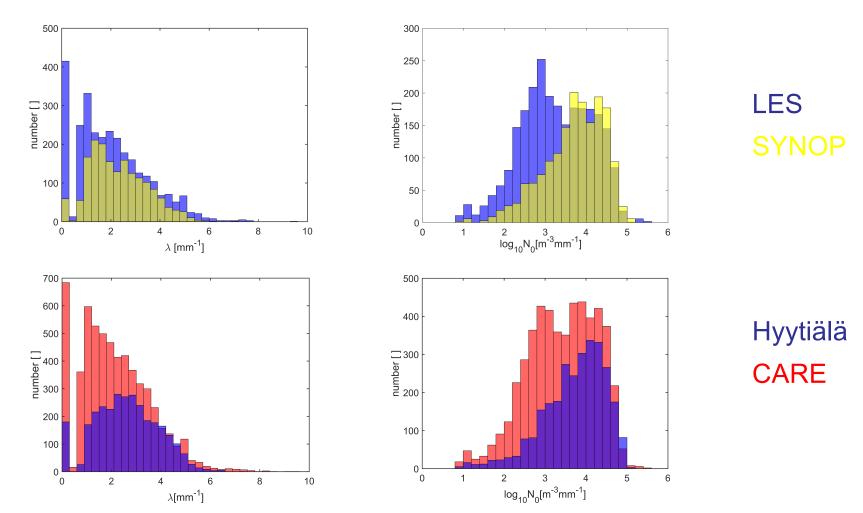
CARE

- Classification based on WKR
- Low-density snowflakes are associated with the LES events



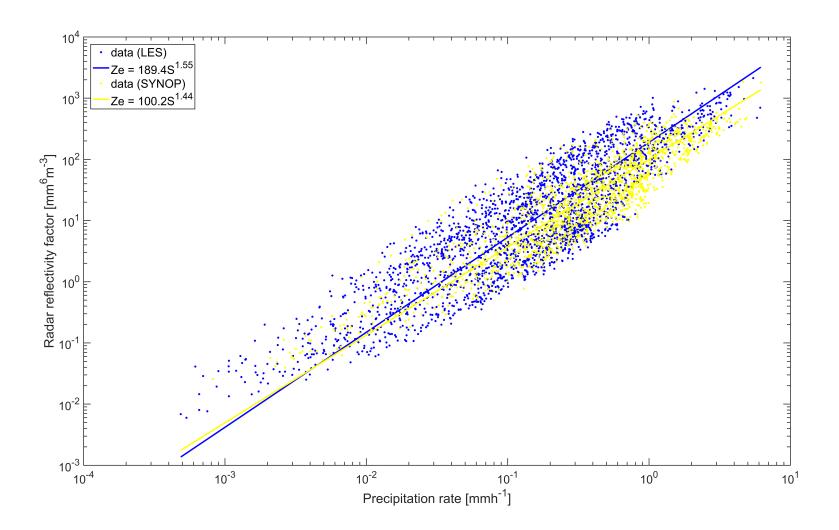


PSD dependence on classification and location

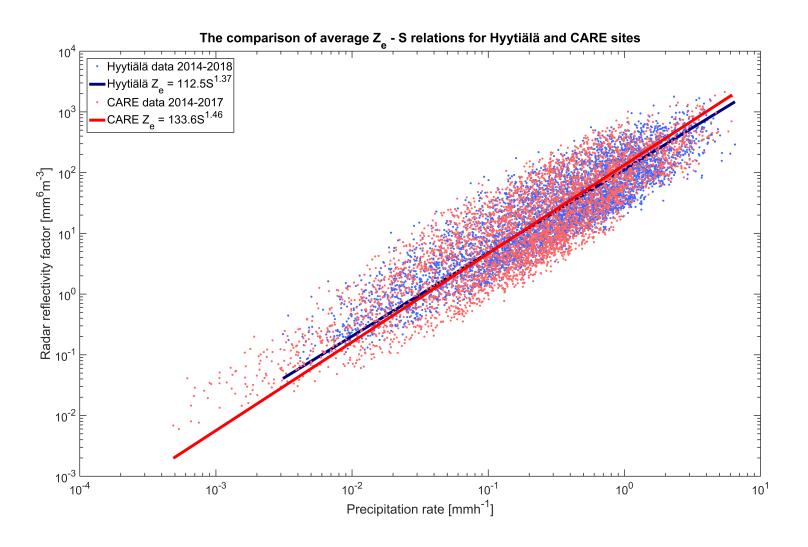




Z-S relations dependence on snowfall classification



Z-S relations at Hyytiälä and CARE



Conclusions

- Differences in the observed and retrieved snow particle properties between CARE site in Canada and Hyytiälä site in Finland
- Snowflakes appear about three times heavier in Hyytiälä, indicating more riming growth
- At CARE site the low-density snowflakes associated to lake-effect are more frequent
- Comparing the different parametrizations of hydrodynamic theory, Heymsfield and Westbrook 2010 seem to describe low-density snowflakes better whereas Mitchell and Heymsfield, 2005 are more suitable for rimed particles.





Thank you.

